



## Advanced Refractory Materials

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**The Albany Research Center is a government-owned, government-operated laboratory in Albany, OR, providing materials solutions that help to make the Nation's energy systems safe, efficient, and secure.**





# Refractories Research at ARC



- Five professionals + support staff.
- > 50 aggregate years in refractory research.
- Research expertise ranges from process control for longer life to the development of improved materials.





# Why DO Refractories Research?

Refractories are utilized in a wide variety of industrial processes, and their performance will often play a pivotal role in defining the efficiency, reliability, and economics of production.



# Recent/Current Research

- OIT/SMA collaboration to reduce slag-line refractory wear in EAF furnaces.
- DOE/FE-sponsored effort to develop improved refractories for slagging gasifiers.





# **Improving Refractory Service Life and Recycling Refractory Materials Used in EAF Steel Production**

**- OIT Industries of the Future -**

**- Steel Program -**

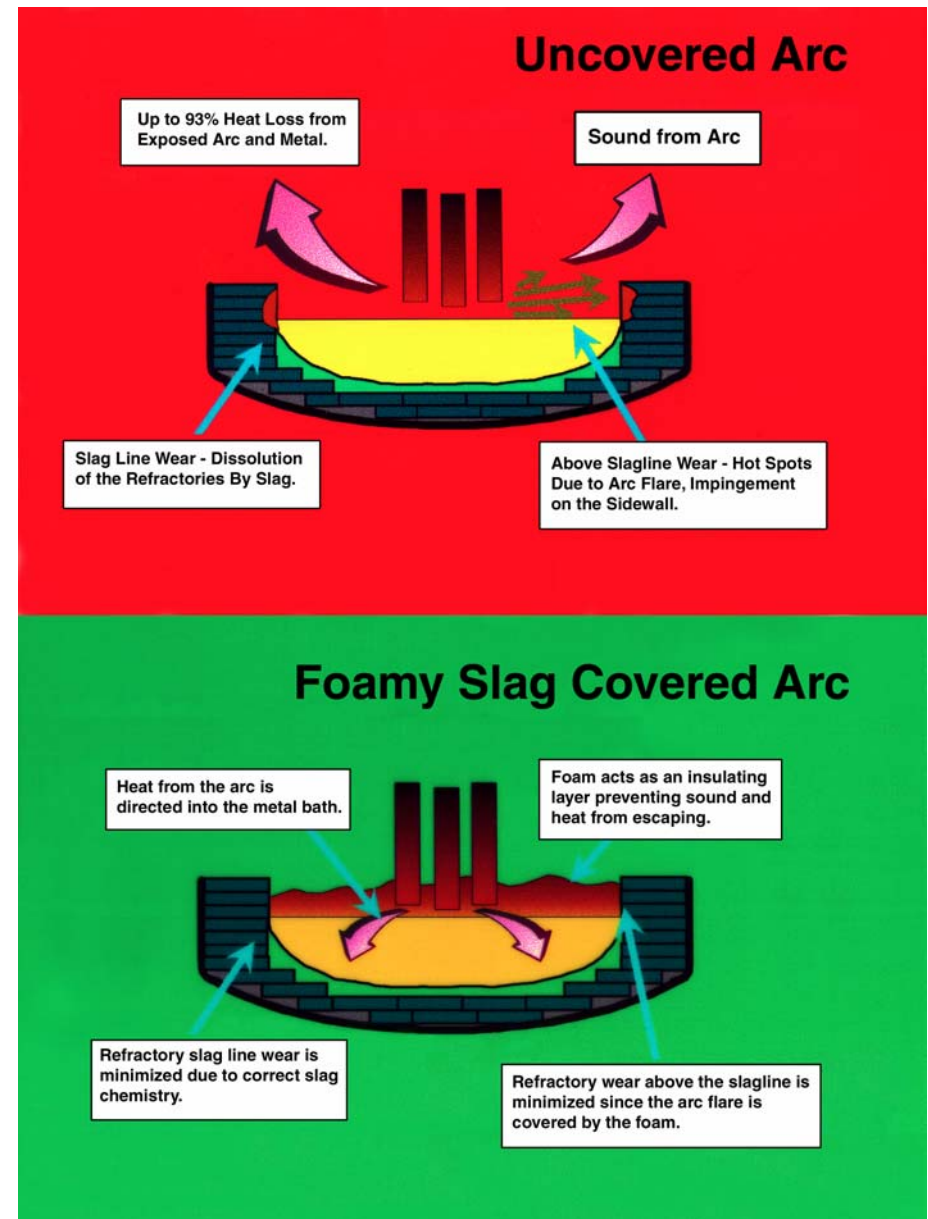
*Joint Program between OIT-USDOE and  
Steel Manufactures Association*



# PROJECT OBJECTIVE

Develop a computer simulation and control system capable of effectively manipulating the slag foaming process for

- Reduced energy consumption
- Reduced noise
- Reduced refractory wear
- Recycling spent refractories





## Program Participants

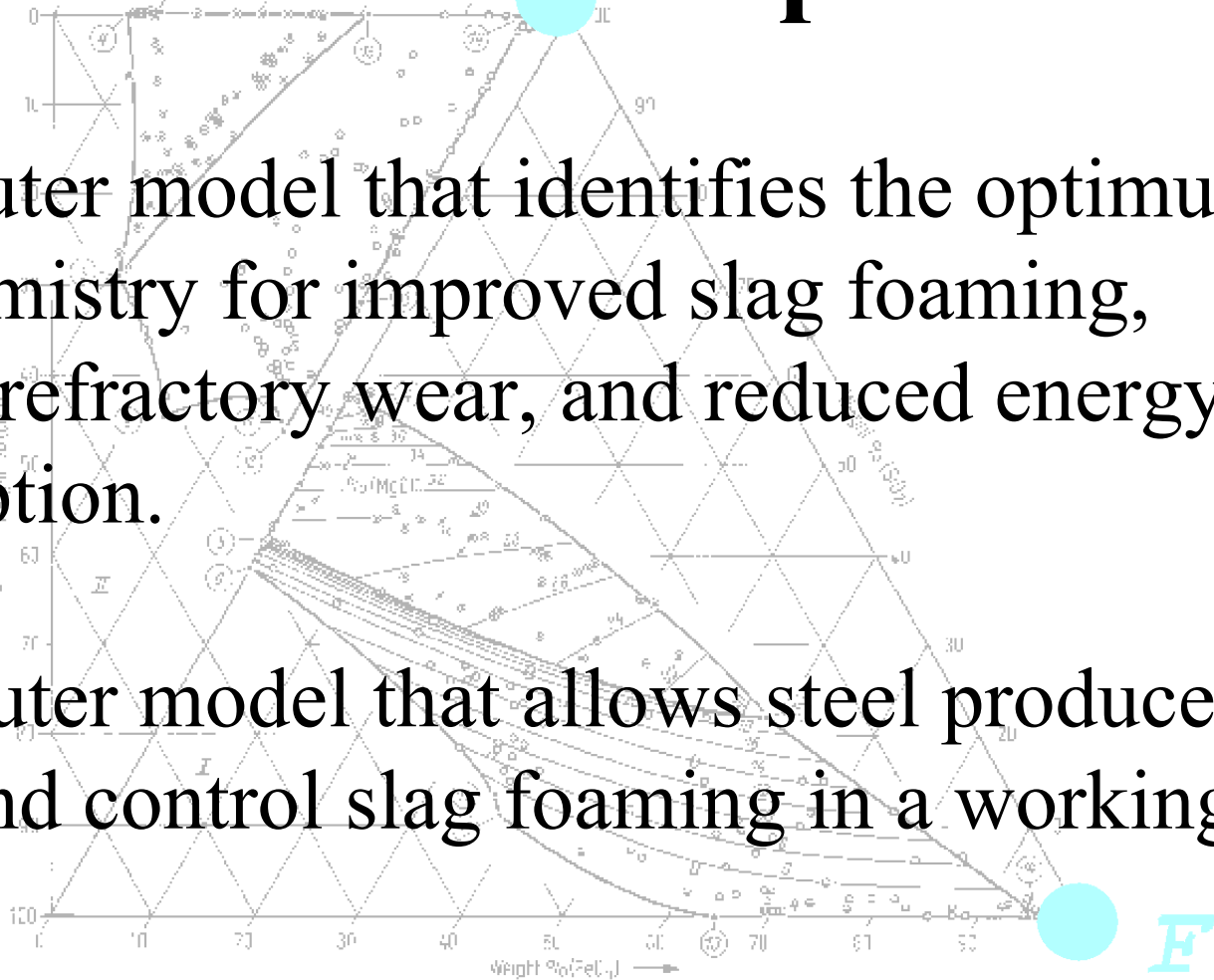
- DOE Office of Industrial Technologies
- Steel Manufacturers Association
- Albany Research Center
- Argonne National Laboratory
- University of Alabama
- Clemson University





# Research Accomplishments

- Computer model that identifies the optimum slag chemistry for improved slag foaming, reduced refractory wear, and reduced energy consumption.
- Computer model that allows steel producers to model and control slag foaming in a working EAF.





# Research Accomplishments

- A determination of the “best practices” for reusing/recycling spent refractories from EAFs.
- Verification that spent refractory materials from EAFs can be used in gunning repair mixes.





# Research Outcomes

1. ***Energy Savings:*** Reduction in energy consumption per ton of steel produced (2-5% = 13 kwh/ton)
2. ***Cost Savings:*** Extension of refractory service life (less material, labor reduction, etc.), reduced electrode consumption – (Economic benefit of \$5/ton of steel)
3. ***Environmental Benefits:*** Reduction of refractory waste streams, reduced NOx, reduction in CO emissions, noise reduction, better environmental image
4. ***Improved Process Control:*** Better steel quality, automated process control



# **Refractory Material Issues in Gasifiers**

Department of Energy/Office of Fossil Energy

Gasification Technologies

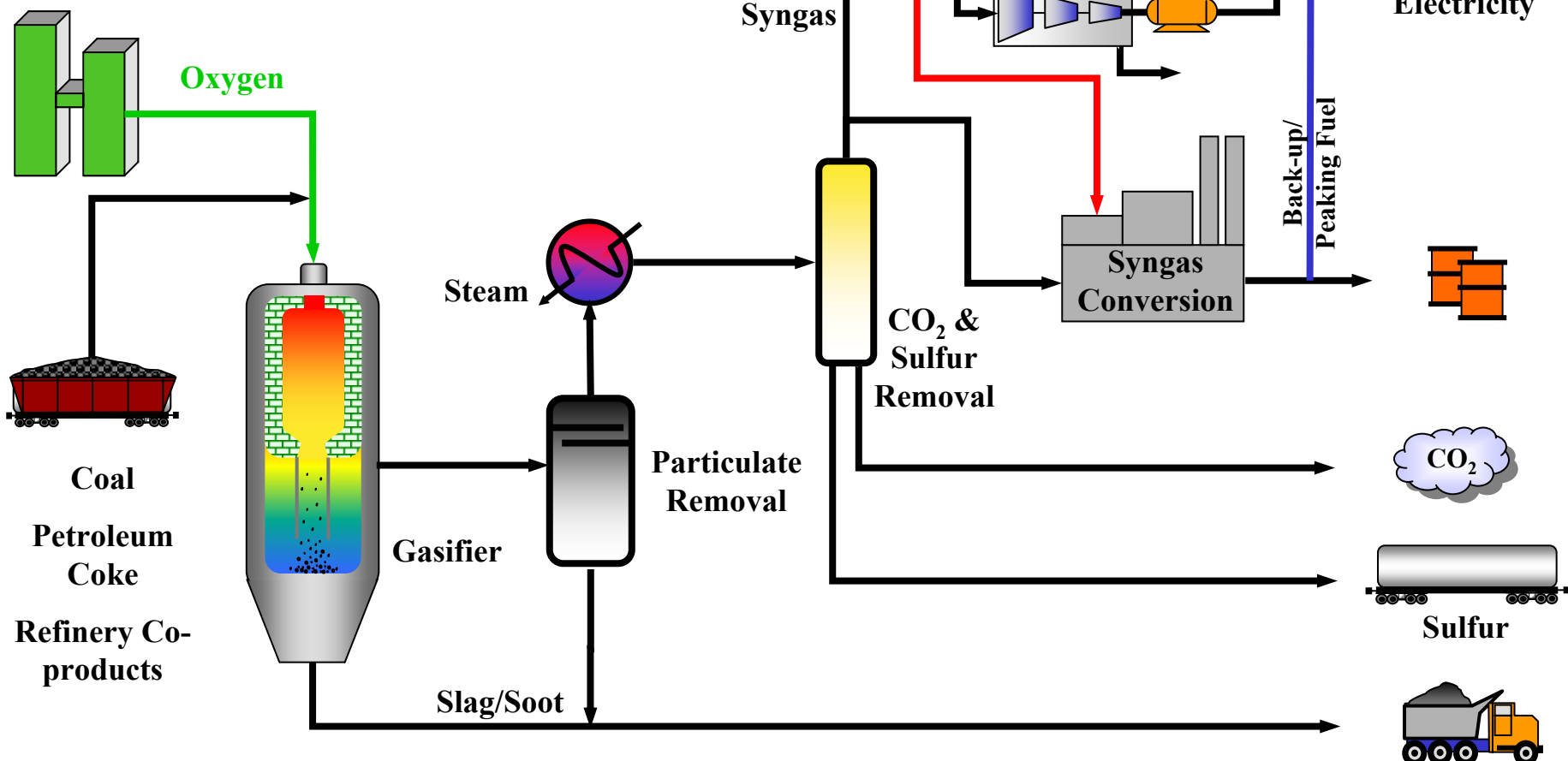
Advanced Research

CRADAs with ANH Refractories, Minteq,  
Engelhard-Clal





# Gasification





Gasifier manufacturers and operators list increased refractory lifetime as one of the most important needs of the industry.



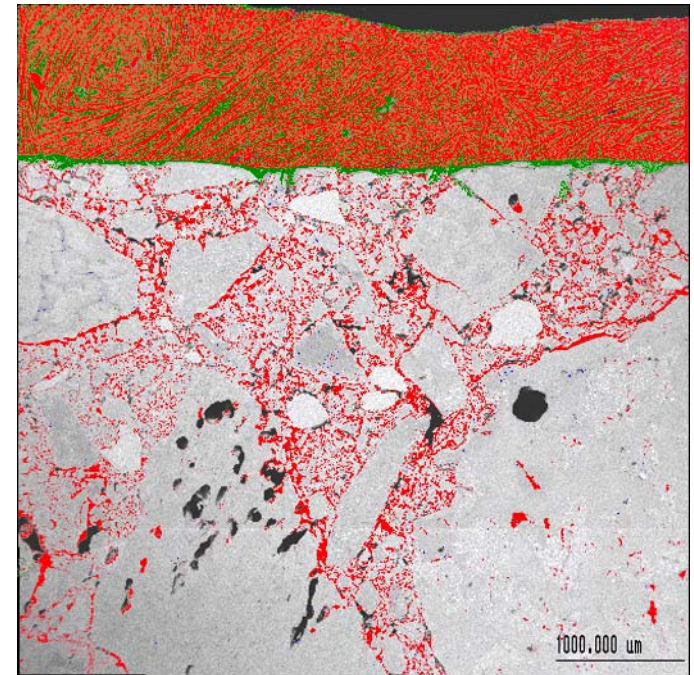
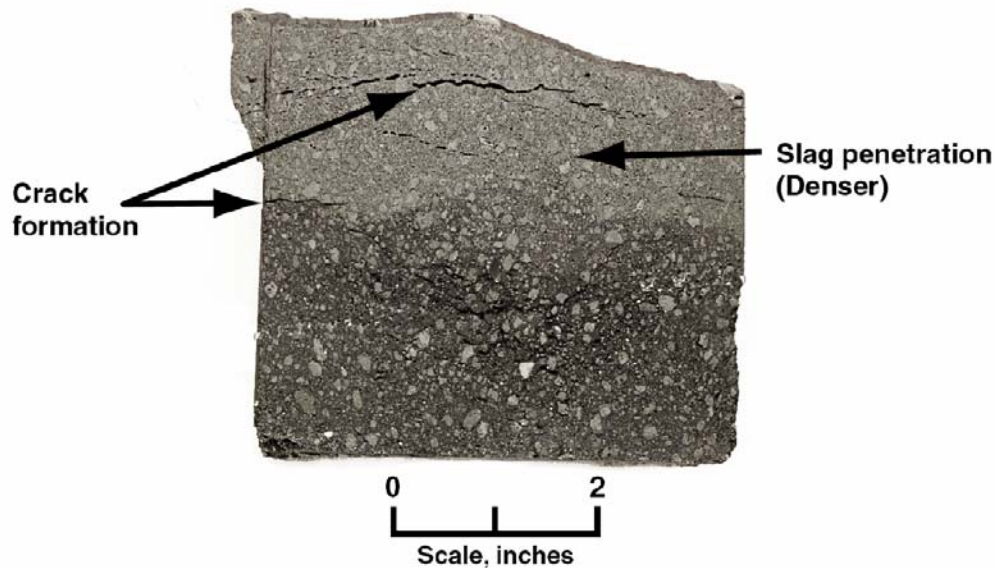


# Project Research Goals:

- Enhance gasifier reliability and economics through the development of
  - Improved refractory materials and repair techniques for longer service life.
  - Longer-life thermocouple assemblies for more reliable temperature control.



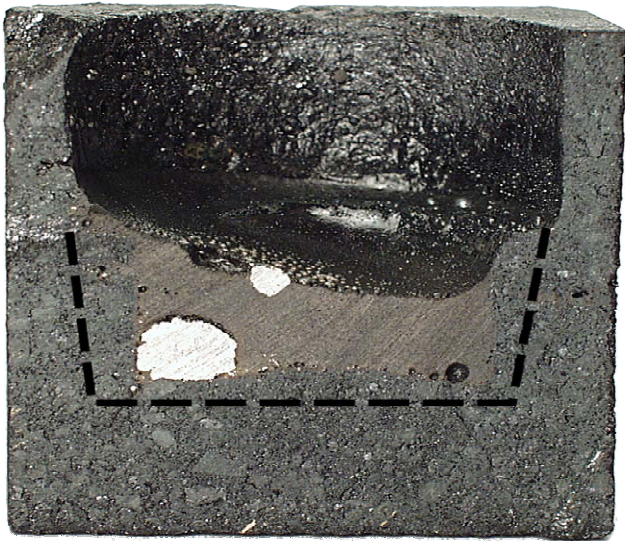
# Gasifier Refractories: *Post-mortem* Evaluation







# Gasifier Refractories Solution



ARC's Improved Refractory



Current Industry Best



# Gasifier Refractories Solution: Next Steps

Scale-up using  
commercial processing  
techniques and  
expanded testing in  
commercial gasifiers.





# Gasifier Thermocouples

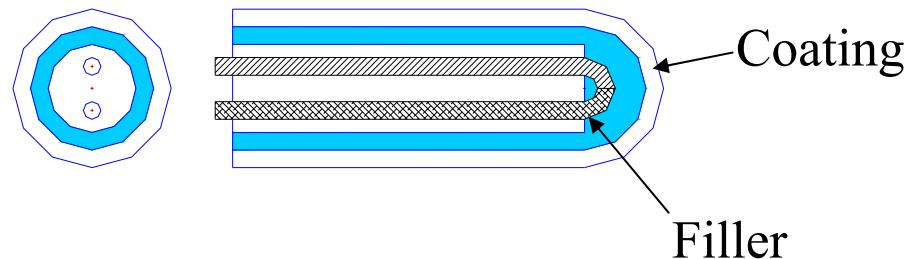
Current “best” thermocouples do not survive more than a few days of gasifier operation





# Thermocouple Solution

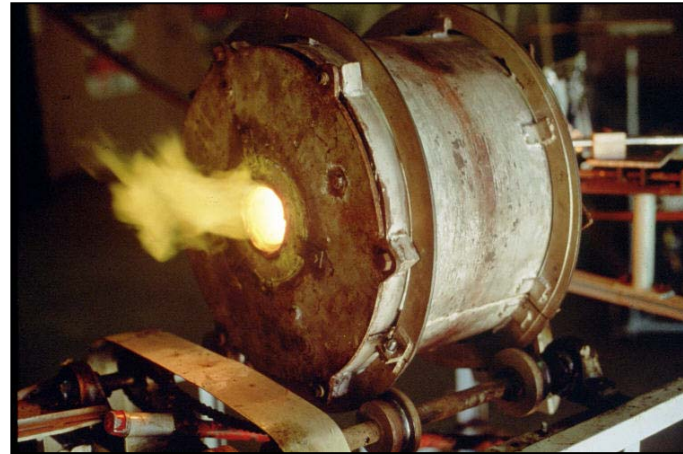
Create a more corrosion-resistant thermocouple protection system through the addition of coatings and an improved filler material.







# Research Capabilities: Exposure Tests





# Research Capabilities







# ARC's Refractories Group

